Support for Farmers' Cooperatives

Case Study Report

The effect of farmers' cooperatives on price stabilization in the dairy sector

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Disclaimer:

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Preface and acknowledgements

In order to foster the competitiveness of the food supply chain, the European Commission is committed to promote and facilitate the restructuring and consolidation of the agricultural sector by encouraging the creation of voluntary agricultural producer organisations. To support the policy making process DG Agriculture and Rural Development has launched a large study, "Support for Farmers' Cooperatives (SFC)", in order to provide insights on successful cooperatives and producer organisations as well as on effective support measures for these organisations. These insights can be used by farmers themselves, in setting up and strengthening their collective organisation, by the European Commission, and by national and regional authorities in their effort to encourage and support the creation of agricultural producer organisations in the EU.

Within the framework of the SFC project, this case study report on the cooperatives role in stabilizing producer prices has been written.

Data collection for this report has been done in the spring of 2012.

In addition to this report, the SFC project has delivered 32 other case study reports, 27 country reports, 8 sector reports, 6 EU synthesis and comparative analysis reports, a report on cluster analysis, a report on the development of agricultural cooperatives in other OECD countries, and a final report.

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1. Introduction

1.1 Objective and research questions

The imbalances in bargaining power between the contracting parties in the food supply chain have drawn much attention, also from policy makers. The European Commission is committed to facilitate the restructuring of the sector by encouraging the creation of voluntary agricultural producer organisations. DG Agriculture and Rural Development has launched a large study, "Support for Farmers' Cooperatives", that will provide the background knowledge that will help farmers organise themselves in cooperatives as a tool to consolidate their market orientation and so generate a solid market income. In the framework of this study, this report provides information on cooperatives' ability to stabilise producer prices in order to avoid harmful effects from world market commodity price fluctuations into farm level.
In this case study, the following research questions have been guiding the research. First, what is the nature of fluctuation in dairy prices in Europe? Second, how is the dairy market integrated horizontally, i.e. has the price fluctuation similar patterns in different EU countries? Third, how is the price fluctuation in the commodity market transmitted to producer prices? And finally and most importantly, have the cooperatives been successful in stabilizing producer prices and do the cooperatives behave differently from investor owned firms (IOF) when setting the producer price?

1.2 Theoretical framework

In the earlier phase of this SFC project we found that in the dairy sector the producer prices seem to be higher in countries where the cooperative market share is larger (Hanisch et al. 2011). Furthermore, we found that in countries where the cooperative market share is large the IOFs seem to pay higher prices than cooperatives. These two findings supported the cooperative yardstick theory. However, stable prices cannot as such be presented as a result of the same theory.

Stable prices are a frequently stated policy goal. For example, two of the five policy objectives of European Union (EU) Common Agricultural Policy (CAP), originally stated in the Treaty of Rome in 1957, are related to this issue: to stabilize markets and to ensure that supplies reach consumers at reasonable prices. The policy objective of stabilizing markets can be interpreted to refer directly to stable prices. The latter objective of reasonable consumer prices is also related to stable prices. If prices fluctuate, the consumer goods would not always be reasonably priced.
This rationale gives the background to the theoretical reasoning why stable prices are worth to be achieved. Schmitz (1984) presented the evolution of welfare economics theory that supports the goal of stable prices.[1]

Waugh (1944) showed that consumers prefer instability since the gains when prices are low exceeds the losses when prices are high. Oi (1961) respectively showed that, in theory, producers as well prefer instability in prices since when prices are high the gains exceed the losses when prices are low. However, the producers cannot react to changed prices in production very fast. Producers could react "correctly" only if the expected prices were realised but this is seldom the case. The dairy production, for example, is partly tight to the biological process (seasonal variation) and on the other hand the production can be increased in the short run only by changing feeding that gives quite restricted possibilities. Decreasing the production is easy but then reaching the same level than before takes time (see also Johnson 1972). In the

[1] The presentation of theoretical framework concerning welfare gains and losses relies on his work.

grain production, weather conditions affect production so much that, according to prices, it is impossible to change production. On the contrary, it tends to be so that supply conditions affect more on prices than demand. If the main driver on prices were demand then producers might react in sowing time to the prices. Thus, in the case of the grain market, the theory of preferring instability in prices cannot work.

Moreover, Massell (1969) showed that even though the producers could act as Oi's theory suggests and the consumers as Waugh's theory suggests separately the joint acting like that would be impossible. Massell showed that policies aiming to stabilize prices increase welfare in general. This is due to the "fact" that when prices are high the producers' gain is smaller than the consumers' loss and vice versa. Later on, also e.g. Samuelson (1972), Newbery and Stiglitz (1981) and Schmitz et al. (1981) have increased the theoretical knowledge on the welfare gains of price stabilization.

An important paper is Timmer's (1989) article where he identified both the benefits from food price stability and the costs of achieving it. He lists the two major schools of thought on food price policy. The neoclassical school favours free trade to maximize efficiency of resource allocation. The structuralist school favours interventions to satisfy goals for income distribution (related to welfare gains). He also points out that this latter goal of income distribution, even though traditionally dismissed by economists as purely political, is justified on economic grounds because of improved macroeconomic and dynamic efficiency from stable food prices. The stable food prices are especially important in developing countries where the staple foods frequently account for a significant share of poor households' budgets (Gouel and Jean 2012).
Price stabilization policies are usually governmental instruments like stocking of goods, price regulation, and trade policy. The empirical literature concerning policy impacts on price stabilization is extensive (see e.g. Rashid 2007, Dorosh 2009, Timmer 2010, Anderson and Neigen 2012).

From the cooperatives' perspective stable prices are important for several reasons. Firstly, if the producers' welfare is increased by stable prices (as shown by Schmitz et al. 1981), then according to the cooperatives' objectives to promote their member producers the dampening of fluctuations expectably should become a cooperative's goal.

Secondly, due to the delivery obligations and delivery rights, the cooperative cannot adjust the production quantities according to prices as it might be possible for an IOF. Thus, cooperatives have a larger incentive to stabilize prices than IOFs. This issue is also related to Williamson's (1981) "transaction specific asset" principle. One of the main goals of the cooperatives is to protect the investments whose purpose is very difficult to change. The cowshed as well as dairy plants are very good examples for this argument. Stable prices are essential in order to be able to protect these investments (see also Ollila 1989 and 2009).

Thirdly, stable prices are usually (though not always) related to stable incomes that can also be a cooperative goal. The stable prices make production more predictable and give a more solid ground e.g. investment decisions on the farm level that are important in order to increase producers' welfare.

Fourthly, if the stable prices brought overall welfare gains even though the producers were unaffected, it could still be in the cooperatives' interest to look for stable prices. This is due to the cooperative nature having also other than profit maximisation goals and thus, if the overall gain of the society is increasing it is reasonable and responsible to try to achieve these goals.
This welfare economics reasoning thus justifies the most important research questions concerning the cooperative role in stabilising producer prices. Moreover, it gives the reasoning also to look at the market integration from both the horizontal and vertical view. One could even

argue that, due to this transmission reasoning, it could be in governmental policy goals to promote cooperatives if they can stabilize prices that affect also consumer prices.

1.3 Analytical framework

There are at least three main factors that determine the success of cooperatives in current food chains. These factors relate to (a) position in the food supply chain, (b) internal governance, and (c) the institutional environment. The position of the cooperative in the food supply chain refers to the competitiveness of the cooperative vis-à-vis its customers, such as processors, wholesalers and retailers. The internal governance refers to its decision-making processes, the role of the different governing bodies, and the allocation of control rights to the management (and the agency problems that goes with delegation of decision rights). The institutional environment refers to the social, cultural, political and legal context in which the cooperative is operating, and which may have a supporting or constraining effect on the performance of the cooperative. Those three factors constitute the three building blocks of the analytical framework applied in this study (figure 1).

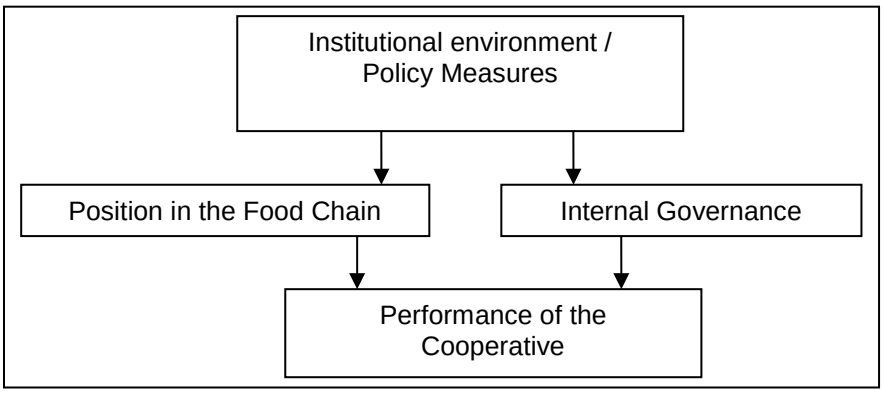

Figure 1. The core concepts of the study and their interrelatedness.

The larger the market share of cooperatives is (the stronger their position in the food chain) the more easily they are able to affect the prices (yardstick theory) and also the price stabilization. If it is found that the cooperatives can affect the more stable price behaviour it is as well an indication of performance. Thus, in this context, the case study on stabilizing prices relies on cooperatives' performance.

1.4 Data and methods

The case study is based on quantitative analyses. We use both advanced co-integration analysis in order to be able to analyse market integration and the price transmission patterns in the dairy sector. Moreover, in analysing the cooperative effect on price fluctuations, we use panel data econometric analyses at EU level and, as a case study, at German level.

The data is collected from different EU sources. The producer and commodity price data is taken from the EU Commission's website and the data for controlling variables from Eurostat. The cooperative market shares are based the data collected in 2011 in this SFC project. The additional data needed to compare cooperative behaviour to IOF behaviour is collected from a dataset available in Germany (www.agrarheute.com) and from the AMADEUS database.

The EU CAP has gone through major reforms during the last decade. The most important change affecting the dairy sector was the gradual decrease in intervention prices of dairy commodities.

This is a clear policy regime change that directly affects the price fluctuation by giving more room for market oriented price formation. This change in the policy regime has to be taken into account in the econometric analyses.

1.5 Structure of the report

Section 2 provides a description on price fluctuation pattern in the EU dairy sector and an analysis on market integration (horizontal and vertical). Section 3 provides an econometric analysis of the cooperative effect on producer price stabilization. In section 4, the cooperative and IOF type pricing behaviour are compared on the basis of a data set from Germany as Europe´s largest dairy producer. Finally, in section 5, conclusions are drawn.

2. Price fluctuation and market integration in the dairy sector

This section, firstly, provides an overview of the price fluctuation patterns in the EU dairy sector. Secondly, the producer prices and their integration in EU countries are analysed as well as the commodity markets. Thirdly, the vertical price transmission between producer and commodity prices as well as between producer and consumer prices is analysed.

2.1 Producer and commodity price fluctuation

The average prices in old and new member states in the EU are presented in figure 2. There are several patterns that need further clarification.

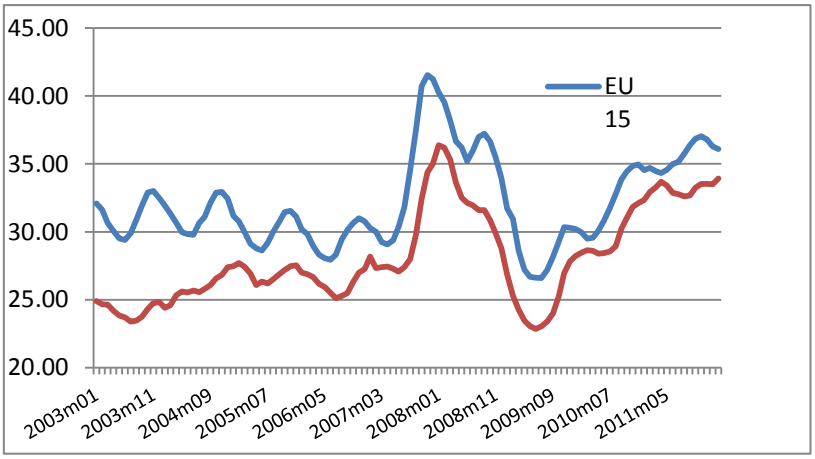

Figure 2: Monthly producer price of milk (cent/litre) in old and new member states from 2003 to 2012 Source: EU Commission

Firstly, there is a clear difference between old and new member states in price level. The difference seems to be decreasing quite rapidly after the EU access (mainly in 2004). Furthermore, the fluctuation in prices seems to have very similar patterns, both in timing and magnitude everywhere in the EU. The difference in price level is explained mainly by different cost levels and the structure of dairy commodity production. In old member states, the role of value added products that probably give better milk margins are higher.

Secondly, there seem to be some differences in pricing systems between old and new member states. The seasonal pricing is much more common among old member states. In seasonal pricing, the prices are lowest when the milk production is highest (in the spring) and the highest when the production is lowest (in late autumn and winter). With this seasonal pricing, dairies have tried to equalize the monthly production such that it would better respond to the more stable consumption. The balance between production and consumption is important because the dairies could optimize their production in order to achieve the best possible economic performance. This seasonal pricing seems to be tied to the North and Middle European tradition. The seasonal pricing is very clear in Germany, France, Austria, the Netherlands, Belgium, Luxembourg, United Kingdom, Ireland and Finland. Of the new members, only in Hungary there is a clear seasonal pricing system in use. Similarly, Southern Europe (Spain, Italy, Portugal, Greece, Cyprus, Malta) lacks seasonal pricing. In many of the countries where a seasonal pricing system is in use, the cooperative market share is also quite large. However, the cooperative market share is probably not the reason for this connection.

Thirdly, the change in the policy regime that affected mainly the old member states is clearly visible. The decrease of intervention prices of dairy commodities (butter, milk powders) in the CAP 2003 reform gradually during the period 2004-2007 affected the producer prices as well. The declining trend can be seen clearly.

Fourthly, the 2007-2008 price spike and the global boom as well the milk crisis in 2009-2010 are clear. The reasons behind these dramatic changes lie mainly in the world market commodity price fluctuation, not in the increased market orientation of EU policy even though it may have had some effect. The demand for dairy commodities increased in 2007 and at the same time the supply was restricted in the world market since large exporters in Oceania (New Zeeland and Australia) were suffering from droughts. The consequence was a price spike that affected also the domestic prices. The export prices spiked and the EU, that is, a large exporter as well had much better opportunities. The supply in the internal market decreased and the prices spiked also in the domestic market since the import competition was lower. The opposite happened in 2009. The supply in the world market increased and the demand decreased. Thus, the commodity prices fell as fast as they have spiked. Even without policy changes, this market change gives the reasoning to separate these two periods in the further analysis.

Referring to the market integration, in figure 3, price development in selected EU countries is presented. The seasonal pricing has been much larger in Finland than in Germany or Sweden. However, the trend seems to be such that the role of seasonal pricing is decreasing. In Sweden the seasonal pattern was abolished in 2001 after the merger of Danish MD Foods and Swedish Arla into Arla Foods. In Denmark there were no seasonal pricing and after the merger the Swedish pricing was adopted to the Danish practice. In Finland the seasonal pricing still exist but it was reduced in 2010.

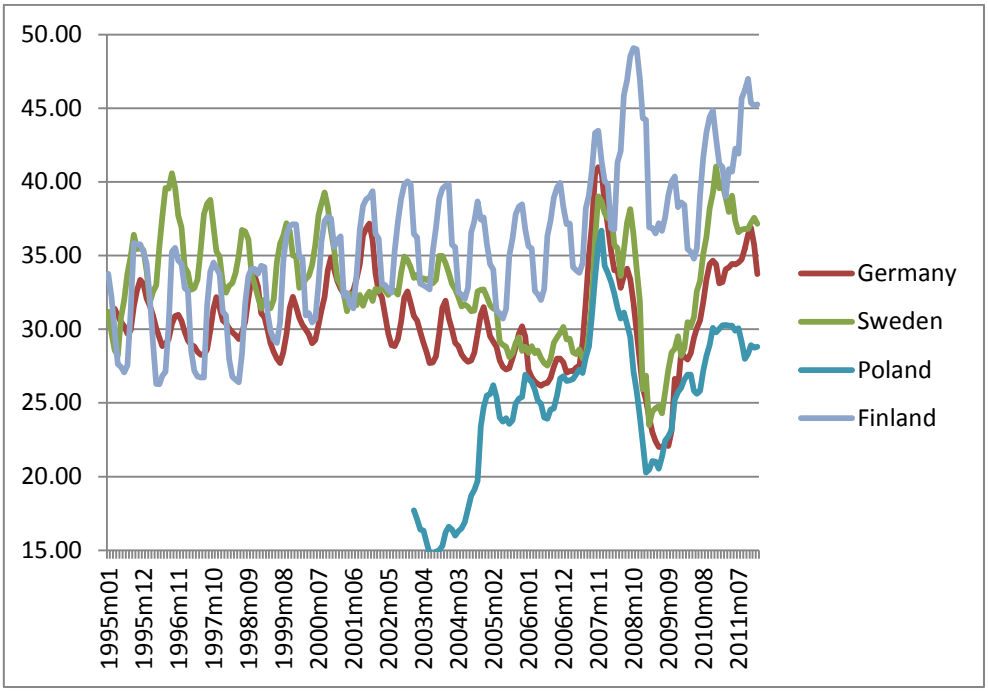

Figure 3: Monthly producer prices of milk in selected EU countries from 1995 to 2012 Source: EU Commission

However, even though there are some differences in price levels and in seasonal patterns there are obvious similarities in the price changes between countries. These are more thoroughly analysed in Section 2.2.

As already noticed, the commodity price fluctuation in the world market has been the main driver for recent price changes. The commodity prices during the last six years are presented in figure 4.

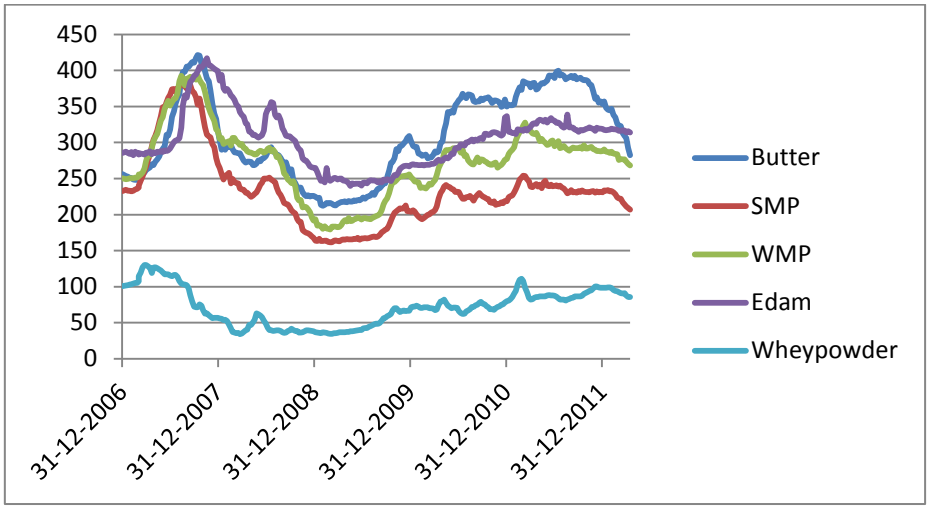

Figure 4: Monthly internal dairy commodity prices (€/100 kg) in EU from 2006 to 2011 Source: EU Commission

The fluctuation seems to be almost similar in every product and the above described changes in producer prices reflect the same fluctuation patterns. These are analysed more precisely the following sections 2.2 and 2.3.

2.2 Horizontal market integration

As the international trade has increased during the last decades, countries have become more dependent on each other. As the EU's domestic market has developed the market integration between European countries has increased.

In this analysis (section 2.2), we concentrate on whether producer prices and prices of commodities in the dairy sector are horizontally integrated. In econometrics, integration of two or more time series is denoted as co-integration if they jointly share the same characteristics. Co-integration also implies that the difference of co-integrated series is independent of time.
As countries are interconnected, a rapid price change in some countries can have immediately impact on a country which is horizontally integrated with it. From a price stabilizing perspective, the horizontal market integration is interesting. If there is a common policy instrument to market stabilization then one can assume that the stabilization may work better in an integrated market. The same holds also from the cooperative perspective. If cooperative pricing aims to stabilize prices and if the cooperative share is large then the stabilization may work better if the markets are integrated.

2.2.1 Co-integration in producer prices between countries

In this analysis, we study producer prices in 26 EU countries. The data covers the period from January 2003 to February 2012 and it is on a monthly basis. The producer price from Malta lacks observations from the analysis period so it is not included in this research.

After the standard pre-examination of time-series properties of producer prices, we approach the co-integration patterns by determining the number of co-integration vectors in pairwise Vector Error Correction Models (VECM). We included two lags and no constant when testing the rank of integration based on optimal lag length in the stationary Vector Autoregression (VAR) model. The decision to neither include a constant nor a trend was based on performed unit root tests. All co-integration relationships between EU countries are summarized in tables 1 and 2.

Table 1: Pairwise co-integrations based on original data

	be	bg	cz	dk	de	ee	el	es	fr	ie	it	cy	lv	lt	lu	hu	nl	at	pl	pt	ro	si	sk	fi	se	uk	
Belgium	.		X	X	X	X	X		X	X	X	X				X	X	X		X		X	X		X		16
Bulgaria		.							X					X			X										3
Czech Rep.			.						X	X					X		X	X					X				7
Denmark				.	X		X		X	X	X	X			X		X	X				X				X	12
Germany					.	X	X		X	X	X	X				X	X					X					12
Estonia						.				X	X			X		X	X					X					8
Greece							.		X	X		X			X		X	X			X			X		X	12
Spain								.	X			X			X												3
France									.	X	X	X			X	X	X	X		X		X			X	X	18
Irleand										.	X	X				X	X	X		X	X	X			X	X	17
Italy											.				X	X	X					X			X	X	12
Cyprus												.		X	X		X	X						X		X	13
Latvia													.	X					X			X					3
Lihtuania														.					X								5
Luxembourg															.	X				X		X					10
Hungary																.	X				X	X				X	11
Netherlands																	.	X		X	X	X			X	X	18
Austria																		.				X				X	10
Poland																			.								2
Portugal																				.							5
Romania																					.		X		X		6
Slovenia																						.				X	13
Slovakia																							.				3
Finland																								.			2
Sweden																									.		6
U.K.																										.	10
																											237

Source: own calculations from EU Commission data

Table 2: Pairwise co-integrations based on seasonally adjusted data.

	be	bg	cz	dk	de	ee	el	es	fr	ie	it	cy	lv	lt	lu	hu	nl	at	pl	pt	ro	si	sk	fi	se	uk	
Belgium	.	X	X				X				X	X	X	X		X			X	X	X	X	X	X	X	X	16
Bulgaria		.	X	X	X	X	X			X	X	X	X			X	X	X				X	X	X	X		17
Czech Rep.			.		X	X	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	22
Denmark				.		X	X		X	X	X		X	X	X	X	X		X	X	X			X	X	X	17
Germany					.	X	X	X	X		X	X	X	X		X	X		X	X	X	X	X	X	X	X	20
Estonia						.	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X	22
Greece							.	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	22
Spain								.	X	X	X	X	X	X	X	X		X	X			X	X	X	X	X	19
France									.				X	X	X	X	X	X	X	X		X	X		X		16
Irleand										.	X		X	X		X	X	X	X			X	X	X	X	X	18
Italy											.	X	X	X	X	X	X	X	X	X	X	X			X		20
Cyprus												.	X	X		X			X			X	X	X	X	X	17
Latvia													.		X		X	X	X	X	X	X	X	X	X	X	22
Lihtuania														.	X	X	X	X		X	X	X	X	X	X	X	22
Luxembourg															.	X		X	X		X	X		X	X	X	16
Hungary																.	X	X	X	X	X	X		X	X	X	22
Netherlands																	.		X				X	X		X	16
Austria																		.	X		X	X	X	X		X	18
Poland																			.	X		X	X	X	X	X	22
Portugal																				.	X	X	X	X	X	X	17
Romania																					.	X	X		X	X	16
Slovenia																						.	X	X		X	22
Slovakia																							.		X	X	20
Finland																								.	X	X	21
Sweden																									.	X	22
U.K.																										.	22

Source: own calculations from EU Commission data

The maximum number of potential pairwise co-integrations is 650 (26*25). Thus, in the analysis based on original time series (no seasonal adjustment) it seems that less than 40 per cent of the potential country pairs are co-integrated (table 1). Moreover, the most integrated countries seem to be among old member states. Respectively, the least integrated ones seem to be among new member states. This probably reflects the different seasonal pricing systems and the market integration in the beginning of the new member states (NMS) EU membership (see figure 2).

When the same analysis was made based on seasonally adjusted time series the number of co-integrated country pairs increased considerably (table 2). Thus, the effect of seasonal pricing systems was eliminated and almost 80 per cent of potential country pairs were co-integrated. Thus, we can conclude that the EU dairy market seems to be very integrated. Moreover, there does not seem to be difference between old and new member states.

2.2.2 Co-integration between dairy commodities

Similarly, applying the same method as in the previous section, the co-integration in the commodity market was analysed. The data consisted of EU internal market weekly prices of main dairy commodities from years 2006-2011. The results are presented in table 3.

Table 3: Co-integration between dairy commodities

	Butter	SMP	WMP	Edam	Wheypow
Butter	.	No	No	Yes	Yes
SMP		.	Yes	Yes	Yes
WMP			.	Yes	Yes
Edam				.	Yes

Source: own calculations from EU Commission data

The dairy commodities are clearly co-integrated. Only the butter market seems not to be co-integrated with milk powder markets. The commodity prices are much more related to the world market than producer prices and it is probably not realistic to assume that cooperatives could affect the fluctuation in the world market.

2.3 Vertical market integration

It is interesting to find out whether the cooperatives can mitigate the fluctuation from commodity markets to producer prices. Before analysing that in section 3 we, however, look at the vertical integration of commodity and producer prices as well as consumer and producer prices in section 2.3. Firstly, we look at whether commodity prices and the producer price are co-integrated and to what extent the change in commodity prices reflect the change in producer price. Secondly, we look at whether producer and consumer prices are co-integrated and to what extent consumer prices change when the producer price changes. If the prices are co-integrated then the possible stabilization of producer prices would also mean more stable consumer prices which would increase the overall welfare. Based on the fact that the EU dairy market is very integrated (analysed in section 2.2) the analysis will be conducted only at aggregate EU level.

2.3.1 Co-integration between commodity and producer prices

Given that the data is non-stationary and I(1), we analyse the price transmission from the commodity prices to the producer price of milk within a co-integration framework. The error-correction specification is estimated using the method of Johansen (1991). This is based on reduced rank restrictions on the vector autoregressive representation, i.e., if the two series are co-integrated, then rank r<2.

More specifically, we test for the presence of co-integration with and without a linear trend between weighted EU27 average producer price of raw cow milk and commodity prices of butter, WMP, edam, cheddar, emmental and wheypowder. We use data from 2003 to 2010 (source: EU Commission). The results of Johansen tests are listed in table 4. Akaike's information criterion was used to determine the optimal order of lags (3 lags for each series). The trace statistics indicate that for both, the with-trend and without-trend specification, we can reject the null hypothesis of no co-integrating vector (r = 0) in favour of one co-integrating vector (r = 1) for bivariate co-integrating tests between the producer price of milk and prices of WMP and wheypowder. This result implicates that producer prices for milk in the EU are integrated to the commodity market process. The test between producer price and price of emmental and the test between producer price and price of butter failed to reject the null hypothesis of no co-integrating relationship. This suggests that these commodity prices and weighted EU27 average producer price of milk do not co-move. In comparison, commodity prices of edam and cheddar were found co-integrated with the producer price of milk, at least without trend.

Table 4: Bivariate co-integration test results between commodity and producer prices.

Tested groups		Rank	Trace test	α=5%	co-integration
ln(butter) and ln(producer price)	model without trend	r=0	7.03	12.53	No
		r=1	0.17	3.84	
	model with trend	r=0	21.15	25.32	No
		r=1	5.85	12.25	
ln(WMP) and ln(producer price)	model without trend	r=0	21.44*	12.53	Yes
		r=1	0.01	3.84	
	model with trend	r=0	27.25*	25.32	Yes
		r=1	3.29	12.25	
ln(cheddar) and ln(producer price)	model without trend	r=0	18.04*	12.53	Yes
		r=1	0.03	3.84	
	model with trend	r=0	24.64	25.32	No
		r=1	4.58	12.25	
ln(edam) and ln(producer price)	model without trend	r=0	14.51*	12.53	Yes
		r=1	0.21	3.84	
	model with trend	r=0	23.12	25.32	No
		r=1	5.52	12.25	
ln(emmental) and ln(producer price)	model without trend	r=0	9.68	12.53	No
		r=1	0.01	3.84	
	model with trend	r=0	23.43	25.32	No
		r=1	6.57	12.25	
ln(wheypowder) and ln(producer price)	model without trend	r=0	13.23*	12.53	Yes
		r=1	0.01	3.84	
	model with trend	r=0	26.92*	25.32	Yes
		r=1	7.85	12.25	

Source: own calculations from EU Commission data

Table 5 presents the coefficient estimates of long-term error correction term (ECT) and coefficient estimates of the adjustment process for the tested bivariate VECM.

Table 5: Estimates of ECM coefficients of the linear VECM, price transmission and adjustment between commodity and producer prices.

Dependent variable	Coeff.	Standard error	Constant	Adjustment coeff.
WMP	-0.618	0.002*	-0.065	-0.149
CHEDDAR	-0.243	0.063*	-0.037	-0.113
EDAM	-0.193	0.053*	-0.045	-0.074
WHEYPOWDER	-0.837	0.020*	-0.052	-0.213

Source: own calculations from EU Commission data

Firstly, all estimated values for the elasticity of weighted EU27 average producer prices are statistically significant. For example, in the pairwise combination of producer price of milk and price of WMP, the estimated value of the elasticity of price transmission into producer price with respect to commodity price of WMP, equals 0.62. Therefore, a one per cent increase in the price of WMP would increase the producer price by 0.62 percentage points. Similarly, the estimated

value of the elasticity of price transmission into producer price with respect to commodity price of cheddar, equals 0.24. This implies that a one per cent increase in the price of cheddar would increase the producer price by 0.24 per cent.

Secondly, all the signs for the adjustment coefficients are correctly signed and statistically significant. More specifically, adjustment between weighted EU27 average producer price and the price of WMP, for example, equals approximately 15 , which implies that after a shock, 15 per cent of the departure from the long-term equilibrium will disappear each month. This means that after seven months the long-term equilibrium will be hit again. Correspondingly, in the case of cheddar, it takes ten months to hit the long-term equilibrium after a shock.

2.3.2 Co-integration between producer and consumer prices

Next, we analyse the milk market in order to determine how producer price changes are passed on to consumer prices. Vertical price transmission is studied based on weighted EU27 average producer price of raw cow milk and weighted EU27 average consumer price of milk products. Our data consists of monthly observations from 2003 to 2010.

Given that the data is non-stationary and I(1), we analyse the price transmission from producer price to consumer price in a co-integration framework. As in the previous section, the error-correction specification is estimated using the method of Johansen (1991).

For simplicity, we use a symmetric model specification although recent empirical results suggest that for most commodities, price transmission tends to be upward asymmetric, i.e. a stronger impact of upward than downward price changes. Among factors that can explain such asymmetries, the literature most often finds two major types of explanation: transaction costs and imperfect competition.

The results of the Johansen tests with and without a linear trend are listed in table 6. Akaike's information criterion was used to determine the optimal order of lags (three lags for both series). The trace statistics indicate that for both specifications, we can reject the null hypothesis of no co-integrating vector (r = 0) in favour of one co-integrating vector (r = 1) for bivariate co-integrating tests between the weighted EU27 average producer price of milk and the weighted EU27 average consumer price of milk products. This result implicates that, in the EU, producer prices for milk are integrated to the consumer prices.

Table 6: Bivariate co-integration test results between producer and consumer prices.

Tested group		Rank	Trace test	α=5%	Co-integration
ln(consumer price) and ln(producer price)	model without trend	r=0	44.24*	33.12	Yes
		r=1	11.05	15.64	
	model with trend	r=0	67.66*	40.14	Yes
		r=1	8.86	22.91	

Source: own calculations from EU Commission data

Table 7 presents the coefficient estimates of long-term ECT and coefficient estimates of adjustment term for the tested bivariate VECM.

Table 7: Estimates of ECM coefficients of the linear VECM, price transmission and adjustment between producer and consumer prices.

Dependent variable	Coeff.	Standard error	Constant	Adjustment coeff.
producer price	-1.835	0.055*	-0.205	-0.129

Source: own calculations from EU Commission data

The estimated value for the elasticity of weighted EU27 average consumer prices is statistically significant. The result implies that a one per cent increase in the producer price of milk would increase the consumer price of milk products by 1.84 per cent.

The sign for the adjustment coefficient is correctly signed and statistically significant. More specifically, adjustment between producer price and consumer price equals approximately 13 per cent, which implies that after a shock, 13 per cent of the departure from the long-term equilibrium will disappear each month. This means that after eight months the long-term equilibrium will be hit again.

As we have shown, the milk markets in the EU are vertically integrated, so that a producer price stabilisation effect directly relates to stable consumer prices. In the next section, we will analyse the effect of cooperatives on volatility. We will investigate whether countries with a large share of cooperatives display more stable producer prices.

3. Econometric analysis on cooperative effect on price fluctuation

Recent concerns from regulators and policy makers on the unequal bargaining power in food value chains (see for example Bundeskartellamt 2012 on dairy in Germany) have given rise to a renewed interest in research on market power in the food sector (Clarke, Davies, Dobson, & Waterson 2002). Most probably also triggered by the growing concentration in the sector and the oftentimes spectacular mergers and acquisitions over the last years, there is also an increasing interest in competition for milk in the academic debate (Graubner et al. 2011a, Graubner et al. 2011b), sometimes also explicitly taking into account the role of cooperatives (Cazzuffi 2012).

In an earlier report within this project (Hanisch et al. 2011) we have asked whether dairy cooperatives have a pro-competitive effect by raising prices and reducing bargaining power imbalances. Drawing on this so-called "Cooperative Yardstick Theory" (Cotterill 1987, Milford 2012, Nourse 1922) we have found that the national share of cooperatives in dairy in the EU–27, indeed, has a substantial positive effect on national farm gate milk prices.

Following intensive discussions of these results in project workshops and at conferences, the question has emerged whether there might be other positive effects of cooperatives on agricultural markets. An issue frequently mentioned in this regard was the role of cooperatives in stabilizing price variations, i.e. in reducing volatility in agricultural markets. These arguments have been theoretically justified by extending the idea of a pro-competitive effect on prices to a "Generalized Cooperative Yardstick Theory." That is, the behaviour of powerful market actors is disciplined by the presence of cooperatives which are theorized to provide a "yardstick" for market conditions under perfect competition more generally; or more simply put, "the larger the share of cooperatives, the fairer are markets." It has also been pointed out in this regard, that the cooperative in its dual nature of a business and a social enterprise has objectives other than profit maximization and – as stated in most cooperative laws – has to advance the economic interests of its members by means other than profit.

Following these arguments, in the next section, we will extend our previous model (Hanisch et al. 2011) to study the effect of the national share of cooperatives on an index of price variation which we will now describe in more detail.

3.1 The modelling framework

Usually, time-series econometrics is used for studying price variation of agricultural markets (Piot-Lepetit & M'Barek 2011). Given the panel structure of our data, which with its range of less than ten years offers little room for time series analysis, like in our previous study, we use the following basic panel regression model (see Allison 2009; Rabe-Hesketh & Skrondal 2008):

$$y_{it} = \mu_t + \beta x_{it} + \gamma z_i + \alpha_i + \varepsilon_{it}$$

where y_{it} is the dependent variable – the coefficient of variation, an index of price volatility for farm gate milk prices.[2] The μ_t are time-variant intercepts, the x_{it} are time-variant independent

[2] The coefficient of variation was constructed as follows. Standard deviations and means for each year (2003 to 2011) were calculated from seasonally adjusted monthly milk price series. The coefficient of variation was calculated as the ratio to be equal to standard deviation divided by mean. It is notable that in the monthly data of 2003 to 2011, the seasonal variation before adjusting was manipulated to base on seasonal variation in years 2003-2006.

variables, the z_i are time-invariant variables, β and γ are parameter vectors to be estimated and α_i and ε_{it} are error terms for constant country effects over time and random variation over time and countries, respectively.

Even though this approach may appear somewhat uncommon for the study of price variation, we think this rather simple empirically driven approach can be justified by the panel structure of our data and the nature of our research question which can hardly be addressed using causal econometrics models in another way. In a broader sense, our work is related to the recent study of (Migliardo, 2012) who analyzes price setting behaviour of Italian firms. In his econometric model, the author seeks to explain the frequency of price changes from sectoral, regional, and firm-level characteristics. Likewise, one could explain price setting behaviour of dairies and include a variable on the legal status, i.e. a dummy variable whether the firm is a cooperative or an IOF. In a next step, one could ask whether the frequency of price changes or price variation measured over a period of time, are also affected by *structural* characteristics of *national* markets. This is what we will do in the following. More specifically, our model regresses national characteristics – including the market share of cooperatives – on the aforementioned coefficient of variation. These variables and the theoretical reasoning for our model will be described in more detail in the next section.

3.2 Variable definition

In our models we use a slightly modified set of variables as compared to our previous study. Most importantly, the dependent variable is different. Here, we use a yearly coefficient of variation based on monthly data from the member states for the years 2003 to 2010. As independent variables we include the year to control whether price variation has (linearly) increased over time. Further, we include the dependent variable of our previous study – the national yearly farm gate milk price – in order to see whether a high price is associated with more variation in prices, as the idea of "risk premiums" in neoclassical economic theory suggests. We also include maize price panel data to see whether there is an effect of fodder prices on price variation in milk. We are aware that it would also make sense to include the variation of fodder prices here to account for potential price transmissions. However, the respective data for fodder prices were not available on a monthly base by the time of the study and we were, thus, unable to calculate the respective variation measures.

We also include a variable of relative trade with consumption-ready fresh milk products with other countries, calculated as the difference between imports and exports divided by total production. In exporting countries, national variation in prices may be to a certain extent smoothened by excess production, while in importing countries price might be comparatively more volatile with (inelastic) domestic demand in excess of supply.

To control for important other characteristics we also include dummy variables for Southern and NMS and (log) GDP. Milk production is comparatively more difficult in the South, but as we have argued earlier also less prone to seasonal variability due to climate. This is directly related to the lack of seasonal pricing in these countries whereas that is common in the North (see Section 2.1).[3] NMS might still be on their way to full integration into the European market. As argued in our previous study, we use GDP as a proxy for instance for income levels or labour and capital intensity in agriculture. The key independent variable of interest in our model – as in our previous study – is the market share of cooperatives measured in per cent of total turnover.

[3] Seasonal adjustment of prices before calculating the volatility measure (CV) should take at least partly into account this seasonal pricing but still the dummy for the South is justified for remaining differences.

Short descriptions of the variables and some summary statistics are presented in the following two tables.

Table 8: Variable description

Variable Name	Description
CV	Modified yearly coefficient of variation based on monthly national milk price data from the member states
YEAR	Year
PRICE	Farm gate milk price
LOGMAIZE	Logged maize price
TRADE	Calculated as (EXPORTS MILK – IMPORTS MILK)/TOTAL PRODUCTION MILK
LOGGDP	Log of per capita GDP
SOUTH	= 1 if country is in Southern Europe
NEWMS	= 1 if country is a NMS
COOP	Per cent market share of cooperatives in dairy

Source: Own compilation based on EU data

Table 9: Summary statistics

	N	Mean	SD	Min	Max
CV	198	3.31	2.60	0.08	12.44
YEAR	297	2005	3.17	2000	2010
PRICE	241	29.68	6.38	13.83	47.50
LOGMAIZE	172	2.73	0.33	2.00	3.51
TRADE	115	0.03	0.17	-0.37	0.79
LOGGDP	297	9.67	0.81	7.44	11.30
SOUTH	297	0.30	0.46	0.00	1.00
NEWMS	297	0.33	0.47	0.00	1.00
COOP	297	50.83	32.96	5.50	100.00

Source: Own compilation based on EU data

3.3 Results

Figure 5 plots the average coefficient of variation on the y-axis against the national market share of dairy cooperatives for the European Union member countries on the x-axis. It can be seen, that there is a negative effect of the market share of cooperatives on our measure of price variation. In other words, at least this explorative graphical analysis suggests that, indeed, a high market share of cooperatives is associated with reduced price variation.

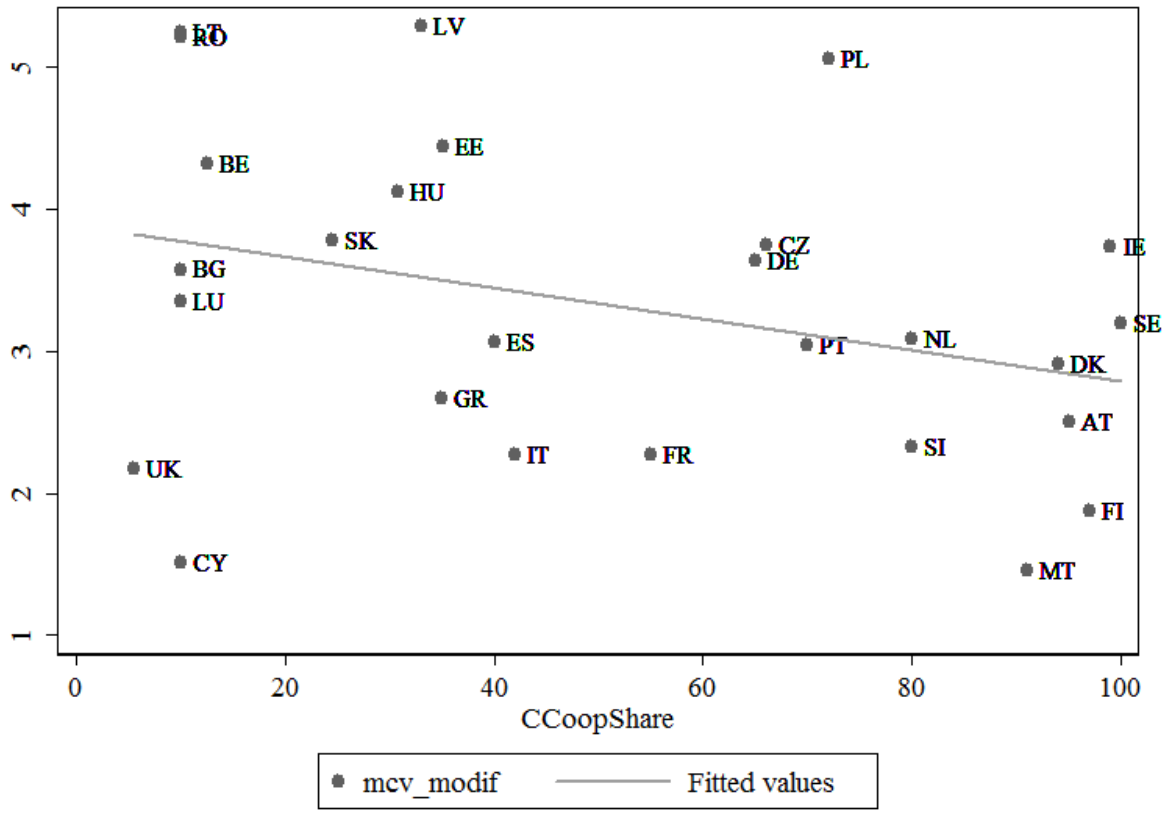

Figure 5: Cooperative market share and price fluctuation in average Source: Own compilation based on EU data

Table 10 presents regression results for different specifications of the above described panel data model.

Table 10: Regression Results

	(1) Random Effects	(2) Random Effects	(3) Fixed Effects	(4) Fixed Effects
YEAR	0.6016***	0.5651***	0.5847***	0.4055
	(0.0762)	(0.1513)	(0.0979)	(0.3201)
PRICE	0.1312***	0.2373***	0.3367***	0.1938
	(0.0438)	(0.0832)	(0.0604)	(0.1362)
LOGMAIZE		2.9177***		3.7408**
		(1.0269)		(1.8130)
TRADE		-4.4280**		-5.9499
		(1.8753)		(3.9066)
LOGGDP	-1.0738**	-2.0025***	-2.2306	2.4649
	(0.4589)	(0.7331)	(1.9093)	(7.2967)
SOUTH	-1.5387***	-4.2897***		
	(0.5392)	(1.2156)		
NEWMS	0.2677	1.3309		
	(0.6630)	(1.1407)		
COOP	-0.0101*	-0.0336***		
	(0.0054)	(0.0125)		
_cons	-1196.2974***	-1123.6842***	-1157.7696***	-850.2598
	(151.8602)	(302.8550)	(184.2587)	(584.9950)
N	160	42	160	42
chi2	84.4986	54.8454		
r2_a			0.3525	0.3802
N_g	22.0000	8.0000	22.0000	8.0000
r2_o	0.3558	0.6243	0.1749	0.0013
F			36.8470	7.4305

Standard errors in parentheses
Own calculations
* p < 0.10, ** p < 0.05, *** p < 0.01
Source: Own compilation based on EU data

The first two columns present the efficient but potentially biased random effects model; the last two columns present fixed effects regressions. To gain more statistical power and reduce selection effects, model specifications 1 and 3 use a reduced set of variables. As can be seen from the summary statistics for trade and maize prices there are a lot of missing observations which substantially reduces the number of observations. Nonetheless, to control for trade and fodder prices, specifications 2 and 4 use the full set of variables respectively. One has to keep in mind that these models may also be more prone to (non-random) selection effects. For example, they may not include many Northern countries such as Finland where maize is not grown and thus no data is available.

Like in our previous study we have used the specification test by (Hausman 1978) to test for systematic differences in coefficients between the more efficient, but potentially inconsistent, random effects models and the less efficient but consistent fixed effects model (also see Allison 2009, Rabe-Hesketh & Skrondal 2008). Contrary to our previous study, the results suggest that differences between coefficients cannot be neglected and that unobserved time-invariant characteristics might have a biasing effect on coefficients when these are not controlled for by using the fixed effects model. However, the test suggest that this bias may be substantially smaller between models (1) and (3), as compared to the test of models (2) and (4) which use the full set of variables and reduce the number of observations to 42.

Overall it can be seen that there is a relatively large effect of YEAR on price variation. Depending on the particular specification a unit increase in the variable is associated with an increase in the variation of coefficient of about 0.4 to 0.6. As already argued earlier, this effect may be attributed to the rapid integration of formerly protected and now largely liberalized European dairy markets ("soft landing") into the world market.[4] It remains to be seen whether this increase over time will continue in the future, for example due to speculation, or whether some stabilization can be achieved. Such phenomena can be studied much better, however, using time series analysis.

The results also show a positive and relatively large effect of the absolute price on price variation. In other words, the higher the price, the more price variation can be observed. As hypothesized in the previous section, this result is consistent with neoclassical economic theory and the idea of "risk premiums".

A similar argument can be brought up for the strong positive effect of maize prices on price variation. High prices in maize might be associated with higher volatility which, then, is transmitted to milk prices. Apparently, we can only speculate on such an indirect effect, given the mentioned data limitations.

Also for TRADE we find a relatively large effect with the expected sign. Exporting countries (TRADE is positive) suffer considerably less from price variation compared to importing countries (TRADE is negative).

For (log) GDP there are negative coefficients except for model (4) where the coefficient drastically changes. This result suggests that in richer countries, prices are subject to less variation. Given the higher likeliness of misinterpretation due to selection effects and model specification we refrain from discussing the GDP coefficient in more detail here.

For the SOUTH variable we find a strong negative effect. As we have argued, seasonal variability in prices might be lower in Southern countries despite of the seasonal adjustment of the price series. From model (1) to model (2) this effect increases substantially. Here, we could at least speculate that there may be some interrelation with the availability of maize data in the sense that, especially Southern countries, where a lot of maize can be grown and data availability may, thus, be good, have a lower variation in milk prices.

We observe a positive relationship between being a new member state and price variation in milk.[5] As hypothesized, integration into the European and increasingly internationalizing markets might have increased price variation in these countries relatively more. This effect remains comparatively small, however, and also here we see a rather drastic change in coefficient size from (1) to (2) which may – again – be indicative of selection effects.

As the graphical exploration has already indicated, we find a price-variation-reducing effect of the market share of cooperatives. Compared to the other coefficients, the COOP coefficient is small, but one has to keep in mind the *scale* of the variable, which is the *percentage* share of cooperatives. For model (2), for instance, moving from a situation with no cooperatives at all to a

[4] There was also a huge change in the commodity prices in the most recent years of the study period. Since the vertical integration is obvious (see section 2.3) the fluctuation in producers prices as well increased.

[5] This is at least partly related to the technical calculation of our volatility measure. If there is a trend (as is the case NMS in early years of their membership when integrating into the EU market) the volatility measured by CV is larger.

situation where cooperatives control the whole market would reduce the variation coefficient by 3.36 (coefficient * 100) – an effect that is much larger than the one we observe for being a new member state (1.33) in the respective model. Likewise, the effect would be 1.01 in model (1), as compared to the 0.27 for the NEWMS coefficient.

4. Price comparison on the firm level – the case of Germany

In our previous study (Hanisch et al. 2011), we have argued that even when the "Cooperative Yardstick Theory" states that cooperatives have a pro-competitive effect on markets as structures, this does not necessarily mean that individual cooperatives as the price-setting economic agents always pay more than IOFs. In this line of reasoning, it could very well be that individual cooperatives have a price setting behaviour resulting in more price variation – for instance because they can count on the loyalty of their members and also provide some other benefits – while still providing a credible threat to other market actors resulting in reduced variation on the market. In the last study, we have already pointed out that in such a case, ironically, dairy farmers trading with IOFs could benefit more from market dominance of cooperatives than the actual members of these cooperatives.

To have a closer look on the firm level, we will analyse the pricing behaviour of selected dairies from Germany – Europe´s largest milk producing country. We put special emphasis on the comparison of cooperatives and IOFs. In our analysis we use monthly time series data of producer prices from 24 dairies from July 2007 until April 2012 which were collected from an agricultural homepage which informs on prices paid by different dairies.[6] In a next step, we have merged these price data with firm-specific financial information – including revenue and profits – from the AMADEUS database.

In our analysis, we will proceed in the following way. In a first step we analyse the time series by plotting the series and using some simple tests to get a first grip on potential differences in prices cooperatives pay as compared to IOFs. In a second step, we develop volatility indicators per dairy and year to arrive at a descriptive understanding of changes in volatility over time and between of cooperatives and IOFs. In a third step, we seek to explain the variance of dairies by their individual characteristics using the supplementary data from AMADEUS as described above. Here, we are limited by the data availability and have to rely on the time span until 2009, for which the AMADEUS data are available. Finally, we summarize our findings with regard to our question whether cooperatives and IOFs differ in the volatility of prices they pay to the producers.

4.1 The German dairy sector

The German dairy sector has witnessed a tremendous concentration process over the last two decades. From 360 dairy producing companies in 1990, less than 100 remained in 2009 (RLV 2011). This process has also produced several large national and transnational mergers, especially over the last five years.[7] Also the German retail market for dairy products and food products is very much concentrated, with five big players dominating the market and (mis-)using their bargaining power. The dairies, in turn, pass on prices to the upstream producers.

It is also important to point out that (dairy) farm structures are regionally very diverse in Germany. The can be broadly described as follows. In the formerly communist Eastern part of the country, successors of collectivist farms have developed into large agricultural producer organizations. In the Northern part family farms and smaller agricultural businesses have larger herds than the South which is characterized by smaller family farms and small herds.

[6] http://www.agrarheute.com/monatliche-auszahlungspreise-molkereien-regionen

[7] Most prominently, the two biggest players on the market, Humana and Nordmilch (both cooperatives), merged in 2011 their operative business to DMK.

About two thirds of the German milk is processed by cooperatives. Most of these cooperatives, by exploiting economies of scale, follow a cost leadership strategy, for example for fresh milk or (non-speciality) cheese, while their IOF counterparts are known for more intensive branding and higher levels of value addition (Ebneth and Theuvsen 2005). Germany is an exporter of dairy products. For example in 2010, it has reached a level of self-sufficiency of 124 per cent (BMELV 2009). In 2009, Germany has experienced the so-classed "milk crisis," an unprecedented decline of producer prices, arriving at a minimum of about 21 Cent per litre, which has been accompanied by farmer-led protests and business closures.

To understand how milk prices are formed, it is also important in this context to elaborate a little bit on how the price setting systems differ between different corporate structures, especially between IOFs and cooperatives (also see Steffen et al. 2009). In cooperative dairies, where patrons are simultaneously owners (members), a collectivistic price mechanism prevails. Members receive the difference between generated returns from sales and costs proportionate to patronage.[8] Monthly pay-outs are calculated according to the operating profit, whereas the Board of Directors decides on a statutory basis upon the price level per litre of delivered milk. By the end of the accounting year, cooperative members receive supplementary payments. Also premiums are often paid for high volume delivery, fidelity, or prolonged contracts. In contrast, IOF dairies pay contracted prices to farmers either individually or collectively via producer organizations (Steffen et al. 2009). Often, also reference prices are paid, based on indices of average national prices or sometimes (spatially proximate) other dairies. This practice has been much criticized lately, however, as it might not comply with competitive law (Bundeskartellamt 2012). Interestingly, FrieslandCampina – Europe´s largest dairy cooperative – and its German subsidiary follow a different price setting mechanism. The monthly "Guaranteed Price" for milk is calculated from the national averages of Germany, Denmark, the Netherlands and Belgium (FrieslandCampina 2012).

4.2 Explorative analysis of German dairy producer prices

To get an idea of the pricing behaviour, figure 6 provides the monthly producer price time series for the dairies studied from July 2007 to April 2012.

The dairies in these data account for approximately 74 per cent of the processed milk in Germany in 2009.[9] The graphs clearly indicate differences in pricing behaviour across firms. For instance, Campina Köln is changing its producer price with a similar frequency as other firms, but with a higher magnitude. Yet, there also is a clear common pattern. A downward trend from July 2007 until the crisis' peak in mid-2009 can be observed for all firms. From mid-2009 onwards, the milk price steadily rises again with some fluctuations. Thus we can analyse two common trends in the price data.

[8] This rule is very simplistic, since it does not consider a more complex and often legislative binding allocation of the net income.

[9] If we consider 28.6 Million tons of delivered milk in 2009. Sources: ZMP, BMELV and annual reports

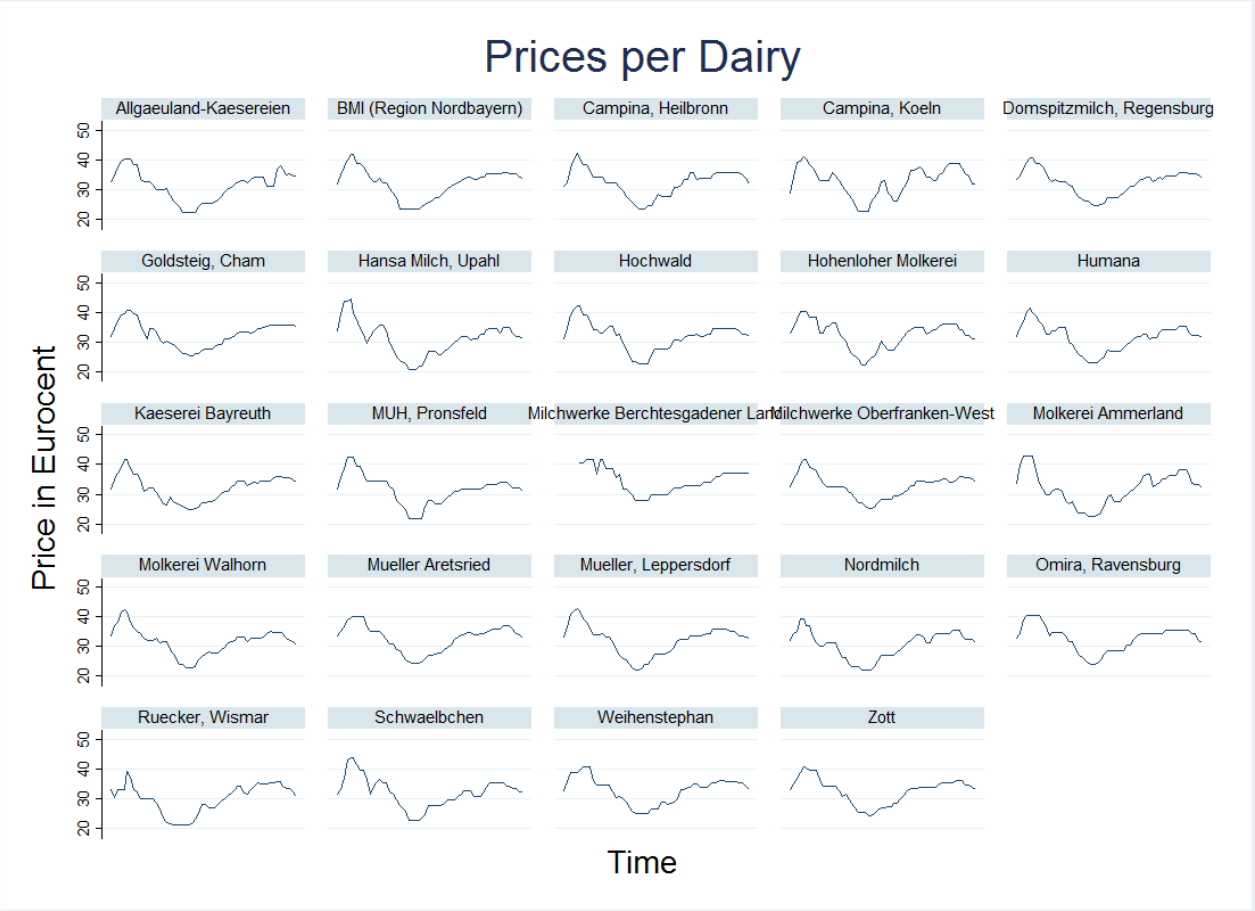

Figure 6: Milk prices per dairy, in Cent per litre, from July 2007 to April 2012 Source: Own compilation based on data from www.agrarheute.de

In order to understand how price time series might be interrelated, we test for co-integration. The Augmented Dickey Fuller test indicates that each time series for all dairies follows a first order integrated process I(1). The same order of integration for the series allows testing for co-integration. The Engel-Granger two-step method indicates that all time-series are multi-co-integrated. This result implies that all prices follow a similar pattern in their movements over time. From this first analysis we can conclude that generally, firms behave quite similar in their price setting behaviour.

4.3 Comparing cooperatives and IOFs in their pricing behaviour

With the aim of establishing a measure for volatility, we first calculate the monthly returns[10], which are the log-linear differences of monthly prices: $R_t = \ln(p_t/p_{t-1})$. These calculations result in a new series of percentage price fluctuations for each month.

For a first analysis, we now aggregate the data for cooperatives and IOFs into two time series and plot them in figure 7.

[10] The term "return" stems from the capital asset pricing literature where many of the methods applied in this section have their origin.

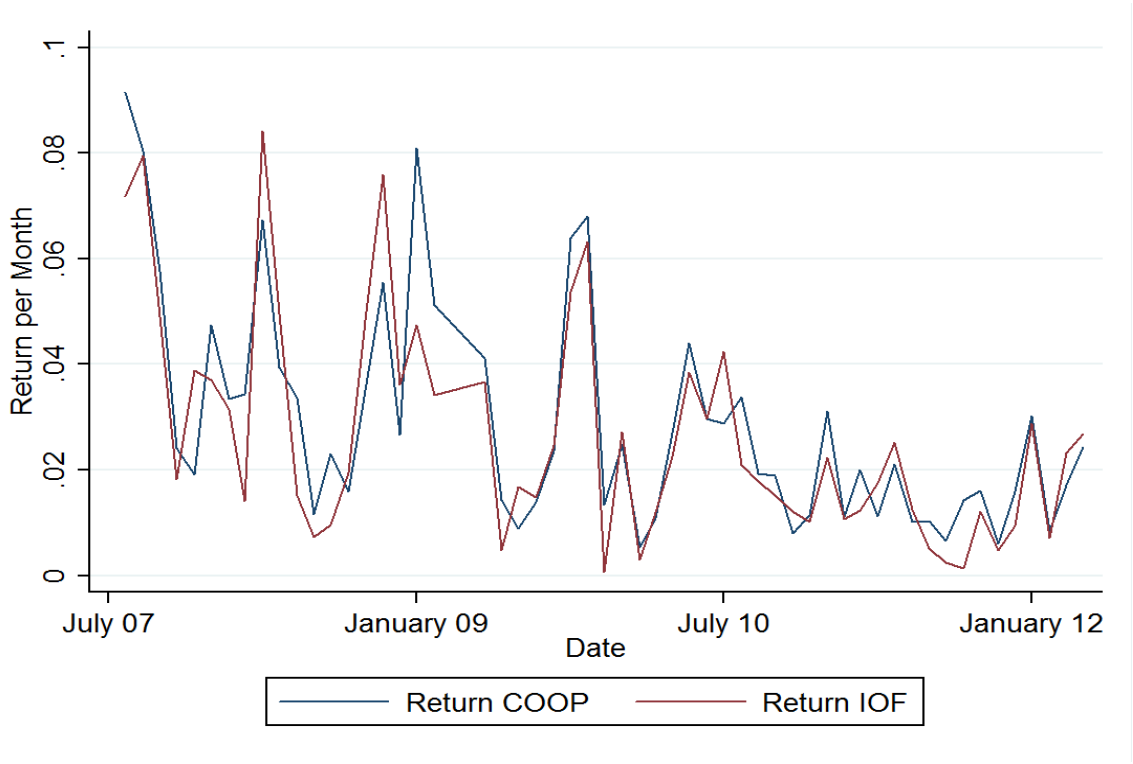

Figure 7: Returns of cooperatives vs. IOFs of aggregated monthly return time series Source: Own compilation based on data from www.agrarheute.de

The graphs indicate that volatility has decreased over time and an Augmented Dickey Fuller test rejects the null hypotheses of a unit root, indicating a stationary process.[11] It can be noted that the magnitude of fluctuations differs only slightly by legal status. For a description of volatility using the aggregated data, we calculate a volatility ratio based on the calculated returns. We opted for a yearly measure and have used the following formula (also see Filler et al. 2010):

$$\sigma_{ann} = \sqrt{\frac{1}{T-1}\sum_{t-1}^{T}(R_t - \bar{R})\text{^}2 * \sqrt{12}}$$

Table 11 provides the calculated measures for the whole period under study and by years.

Table 11: Historical volatility between Cooperatives and IOF

Volatility	**Overall**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
COOP	0.153	0.178	0.149	0.170	0.085	0.080	0.058
IOF	0.142	0.186	0.150	0.145	0.080	0.058	0.065

Source: Own calculations based on data from www.agrarheute.de

As already indicated in the graphical analysis, it can be seen that volatility has decreased over time, independent of the legal status. Differences over time are much larger than differences between cooperatives and IOFs and on average the volatility is lower for IOFs. In this context it is notable that volatility of the cooperative data has been higher especially for the second half of the study period, whereas it is even slightly below the IOF time series for the first half. As in the

[11] It could be promising to extend this analysis by considering structural breaks etc. in the data for a later draft of this paper.

next part of the analysis we use only data on the first period of our price panel one could get the (wrong) impression that cooperatives reduce volatility.

Summing up this section, we can state that volatility over time is much larger than volatility between different types of firms. No substantial difference exists between cooperatives and IOFs, even though, on average, prices paid by cooperatives are slightly more volatile. We will move from these aggregated data down to the level of the firm and try to explore this question in more detail by explicitly taking into account firm level information.

4.4 The determinants of firm level volatility of German dairies

In what follows, we investigate the effect of dairy-specific characteristics on producer price volatility of milk prices. Our panel data consists of 24 dairies, each of which with volatility measures for three years. Unfortunately, the number of observations is reduced as the AMADEUS data were not available for four out of six IOF dairies. This makes the analysis very difficult as the comparison would be based on only two benchmark firms for the IOF case. A description of the variables and summary statistics are presented in table 12.

Table 12: Description of variables and summary statistics

Variable	Description	N	Mean	SD	Minimum	Maximum
VOLATILITY	Annual historical volatility	71	16.24	6.116	7.568	36.86
COOP	=1 if cooperative	72	0.750	0.436	0	1
LOGREVENUE	Log of annual operating revenue	70	12.90	1.134	7.440	14.77
SOUTH	=1 if located in Southern Germany	72	0.708	0.458	0	1
LOGCURRRATIO	Log of current ratio	53	0.331	0.393	-0.511	1.118
LOGPROFMARGIN	Log of profit margin	42	-0.440	1.230	-3.219	1.617
PROFIT	Profit/Loss before tax	52	2892	8821	-20251	32495

Source: Own compilation based on data from www.agrarheute.de and AMADEUS

We will counter the problem of missing data similar to what we did in section 3 and include the variables into our models in blocks. We will, thus, estimate two series of models. The first only includes three explanatory variables for which we have more than 70 observations, namely COOP, SOUTH, and LOGREVENUE. In the second model, we include more data from the financial statements at the cost of losing observations. This allows us to develop an understanding of other factors which might determine price volatility of dairies. As a consequence, our data is subject to a selection bias which might be substantial given that we lose two thirds (four out of six) of the IOF dairies. In addition to the non-probability sample characteristics and the selection bias resulting from the price data (a website, see above), our results should, thus, be treated with great caution.

Table 13 presents our regression results for the limited set of variables (also see section 3 for a model formulation).

Table 13: Regression results German case study 1

	(1) Pooled Model	(2) Random Effects	(3) Fixed Effects
COOP	-0.746	-0.714	
	(-0.47)	(-0.41)	
LOGREVENUE	-0.789	-0.790	-0.679
	(-1.26)	(-1.21)	(-0.63)
SOUTH	-6.951***	-6.945***	
	(-4.51)	(-4.15)	
constant	32.00***	31.98***	25.17*
	(3.62)	(3.47)	(1.81)
N	69	69	69
R2	0.240		0.009
chi2		17.36	

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Source: Own compilation based on data from www.agrarheute.de and AMADEUS

As in section 3, we use Hausman's (1978) procedure for testing for systematic differences in coefficient and potentially biased estimates arising from not controlling for all time-invariant characteristics of firms. The test cannot reject the null hypotheses no difference in coefficients, thus the more efficient random effects model is consistent. Comparing the pooled model to the random effects model does not show much difference, indicating little problems with correlated error terms. The coefficient for the COOP variable is negative which is in line with the findings presented in the previous section stating that volatility was lower in the first half of the study period. The strong effect of SOUTH might be caused by the very different (dairy) farm structures. In the southern part of Germany, smaller farmers often deliver their (high quality) produce for speciality cheese production and it could also be that the relatively close high-price Italian export market has a smoothening effect. Comparing the two coefficients in size, we get a good idea of the relative importance of the two variables. The (volatility reducing) effect of a dairy being located in the South is almost ten times higher than the effect of being a cooperative. This could give us some hints that the economic importance of such an effect might be rather small compared to other factors. There is also a volatility reducing effect of log revenue i.e. higher revenue reduced volatility.

The second series of models, which we present in table 14, also include variables taken from financial sheets of the dairies. As mentioned earlier, for six firms there was no such data. Four out of these six firms were IOFs with relatively low volatility. This selection effect has to be kept in mind when interpreting the results.

Table 14: Regression results German case study 2

	(1) Pooled Model	(3) Random Effects	(2) Fixed Effects
COOP	-5.249*	-5.203*	
	(-1.99)	(-1.87)	
SOUTH	-6.480***	-6.458***	
	(-2.88)	(-2.76)	
LOGCURRRATIO	-0.681	-0.630	0.482
	(-0.26)	(-0.23)	(0.07)
LOGPROFMARGIN	2.013**	2.048**	1.735
	(2.13)	(2.13)	(0.93)
PROFIT	-0.000148	-0.000142	0.000240
	(-1.06)	(-0.99)	(0.70)
constant	28.00***	27.91***	16.40***
	(10.46)	(9.98)	(5.18)
N	41	41	41
R2	0.459		0.161
chi2		27.35	

t statistics in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01
Source: Own compilation based on data from www.agrarheute.de and AMADEUS

Again, the Hausman test could not reject the null hypothesis of consistent estimates in the random effects model. Given that all but two IOFs drop out of the data we refrain from interpreting the COOP coefficient in this model. Again we find a volatility reducing effect of dairies being located in the south of Germany of similar size compared to the other models which is a good indication of the robustness of this finding. Besides, our model suggests that a dairy´s profit margin has an increasing effect on volatility, whereas profit margins and current ratios decrease volatility. A high current ratio implies much liquidity and thus a solid fundament to absorb price shocks and to smooth producer prices. Dairies with higher profits before taxes also offer less volatile prices to farmers. This makes intuitively sense because high profits allow some smoothing. If a firm is very profitable, it can more easily absorb shocks and hence provide more stable prices to producers.

Overall, the data are in line with our intuitive assumptions and theoretical reasoning. However, given the mentioned methodical limitations these findings have to be treated with care. At this point, it seems reasonable to conclude that there is no difference in volatility of *individual* dairies regarding their legal status. As stated above this finding is consistent with the "Cooperative Yardstick Theory" which is more explicit on *market* effects and does not necessarily require that the behaviour of *individual* firms differs. It very much looks like the price depends on other factors – most importantly perhaps supply, demand, and region – and that price volatility cannot be easily explained by firm-level characteristics. Better data and perhaps a look at the *frequency* of price changes, as has been done for example by (Migliardo 2012), could be promising approaches for taking up this question again in the future. A very interesting finding of our analysis was that substantial differences in volatility might exist between the north and the south of Germany. Exploring this question in greater detail in the future could also further advance our understanding of the determinants of milk price volatility.

5. Overall conclusions

In an earlier phase of this SFC project we found that in the dairy sector the producer prices seem to be higher in countries where the cooperative market share is larger (Hanisch et al. 2011). Furthermore, we found that in countries where the cooperative market share is large, the IOFs seem to pay higher prices than cooperatives. Both findings supported the "Cooperative Yardstick Theory" and allowed us to draw respective conclusions for policy makers interested to support dairy farmers on the basis of absolute producer price terms.

Because not only the magnitude of producer prices for dairy farmers but also to reach price stability is an often stated policy goal, in this study we have further analysed to what extent the presence of a strong cooperative sector can and should influence the impacts of price volatility on dairy producers.

In the first section a brief review of literature allowed us to draw a theoretical link between producer and consumer welfare and the reduction of volatility on the market for dairy products. The second section provided an overview of recent price fluctuation patterns in the EU dairy sector and analysed producer prices and their integration in EU countries as well as the commodity markets. In addition, the vertical price transmission between producer and commodity prices as well as between producer and consumer prices was analysed.

We found that, in terms of price levels, in the past there has been a clear difference between old and NMS. This difference seemed to be decreasing quite rapidly after the NMS' EU access (mainly in 2004). Furthermore, over the last ten years, the fluctuation in prices seemed to have had very similar patterns, both in timing and magnitude everywhere in the EU.

Another pattern analysed with regard to market integration were the differences in pricing systems between old and new member states due to seasonal pricing. When the effect of seasonal pricing systems was accounted for we could show that almost 80 per cent of potential country pairs were co-integrated. We concluded that over the last ten years, EU dairy markets became very integrated. Moreover, the differences between old and new member states disappeared. On-going price liberalization seems to have tied the EU dairy market closer to the world market with known problems of increased volatility.

Before the background of the main findings from the analysis of market integration and price transmission in the third section we analysed the more general role of cooperatives in price stabilization across the EU in which, on average, 60 per cent of the milk production is handled by the cooperative sector.

We argued that out from the perspective of a producer owned processing industry stable prices are important for several reasons:

- due to members' rights to deliver to a cooperative cannot adjust the production quantities thus, we assumed that cooperatives have a larger economic incentive to stabilize prices than IOFs.
- if in general, as was stated by the theory, the producers' welfare is increased by stable prices then stabilization should become an issue of member promotion.
- if in particular stable cash flows are essential in order to protect the specific assets of members, stabilization should become an issue of cooperative member promotion.

In section 3 we asked whether the frequency of price changes or price variation measured over a period of time, is affected by structural characteristics. For analysis, we used a yearly coefficient of milk price variation based on monthly data from the member states for the years 2003 to 2010. The independent variable of interest in our model was the market share of cooperatives measured in per cent of total turnover. We found a price-variation-reducing effect of the market share of cooperatives. In addition we could show how the issue of being a new member state still affected price fluctuation and maybe most surprisingly that a regional difference between the north and the south of Europe in terms of volatility existed with slightly lower volatilities in the south.

In section 4, we further explored differences in price volatility down to the firm level. Given the differences in data availability between the EU member states in general and between cooperatives and IOFs in particular, this explorative analysis clearly pushed quantitative analysis to its limits. We analysed data from the case of Germany, Europe's largest dairy producer and differentiated pricing between investor owned dairies and producer owned dairies. We found that general volatility over time was much larger than volatility between different types of firms. In terms of volatility of prices paid to producers we found that no substantial difference existed between cooperatives and IOFs, even though on average prices paid by cooperatives were a little more volatile. On the firm level disaggregation caused problems with data availability. However, using Germany as an example case to make the rather solid findings of section 3 more plausible, we find for Germany that the coefficient for the COOP variable on volatility is again negative. Again, we found an effect of the region on volatility which for Germany we can attribute to the different farms structures between south and north and the proximity of southern dairies to neighbouring countries like Italy which due to different product orientation are known to have relatively higher and stable milk prices. We concluded that further disaggregation caused data problems but could in general underpin the patterns identified in the previous sections.

On the basis of our findings we generalize and draw conclusions for policy as follows:

1. The market for dairy products has increasingly integrated over the last decade. In the NMS, the price levels have caught-up. Liberalization has worked but increased the general pattern of volatility in the European dairy sector.

2. Cooperatives have an effect on the developments on the market. Given the imbalances on the dairy market the competitive yardstick effect of cooperatives in Europe on the level of prices has been identified in a previous study. In this study we first established why cooperatives - given the integratedness of markets - should also have an interest in stabilizing prices. We then went on to show that this influence is measurable in this more and more integrating European market. We conclude that a dairy industry owned by producers has an impact on both policy goals often mentioned by EU-policy makers, fairer price levels and reduced price fluctuations. As such a vivid cooperative sector in Europe is already working towards fairer markets in a broader sense.

For policy we conclude that if price stabilization and a fairer level of prices for producers remain on the agenda of EU policy it may make sense to support the development of a healthy cooperatively organized dairy sector. The policies articulated in the current milk package are an important step in this direction. However, market imbalances in the food sector in general and in the dairy sector in particular remain problematic features. Neither competition policy nor national anti-trust agencies have managed to avoid imbalances triggering further concentration processes among retailers and food processors. Producers are somehow trapped between the problem of losing control over their ever increasing and professionalizing cooperatives due to

increasing problems of agency and collective action and between the problem of participating in horizontal integration and growth processes necessary to negotiate fair terms.

As the experience with NMS which are lagging behind in terms of cooperative sector organization has shown, it is not a realistic scenario to assume that in such a dynamic growth environment new structures of farmers organizations will easily form and gain control. In the future the question how farmers can be best supported to better control their traditional but ever increasing cooperatives may become relevant. In the process, policies in support of strengthening incentives for office bearers in honorary posts to seriously and effectively express the interests of members vis-à-vis management may become more relevant in the future. At the same time further support for the efforts of newly emerging producer organizations to coordinate activities may apart from regulations in the milk package become more policy relevant. However, because the goals of emerging PO are often "price protective" and therefore not in line with the reform agenda of the CAP policy makers, such support measures have to be wisely calibrated.

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